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Indian Standard

SPECIFICATION FOR INHIBITED MINERAL INSULATING OILS

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March 1989

AMENDMENT NO. 1 OCTOBER 2010
TO
IS 12463 : 1988 INHIBITED MINERAL INSULATING OILS

(*Page* 1, *clause* **0.2**, *line* 8, *clause* **1.1.2**, *line* 2, *clause* **2.0**, *line* 3) — Substitute ‘1993’ *for* ‘1983’.

(*Page* 1, *clause* **0.2**, *line* 9, *clause* **2.0**, *line* 4) — Substitute ‘fourth’ *for* ‘third’.

(*Page* 2, *clause* **5.1**, *line* 2) — Substitute ‘210’ *for* ‘200’.

(*Page* 2, *clause* **5.1**, *line* 3) — Add ‘The oil may also be delivered in perfectly clean steel drums conforming to IS 2552:1989[0]’ after ‘IS 1783-1983[*]’.

(*Page* 2, *clause* **5.1**, *line* 18) — Add ‘[0]Steel drums (galvanized & ungalvanized) (*third revision*)’ after ‘† Specification for hot-dip zinc coating on structural steel and other allied products (*second revision*)’.

(*Page* 2, *clause* **6.1**, *line* 2) — Substitute ‘2003’ *for* ‘1973’.

[*Page* 3, *table* 1, *Sl No.* (ii), *col* 4] — Substitute ‘1990’ *for* ‘1977’.

[*Page* 3, *table* 1, *Sl No.* (v), *col* 4] — Substitute ‘1992’ *for* ‘1970’.

[*Page* 3, *table* 1, *Sl No.* (viii), *col* 4] — Substitute ‘Annex B of IS 335:1993[7]’ *for* ‘Appendix A of IS 335-1983[7]’.

[*Page* 3, *table* 1, *Sl No.* (ix), *col* 4] — Substitute ‘1992’ *for* ‘1971’.

(*Page* 3, *table* 1, *Note* 3, *line* 3) — Substitute ‘third’ *for* ‘second’.

(*Page* 3, *table* 1, *Note* 3, *line* 7) — Substitute ‘second’ *for* ‘first’.

(*Page* 3, *table* 1, *Note* 3, *line* 10) — Substitute ‘fourth’ *for* ‘third’.

(*Page* 3, *table* 1, *Note* 3, *line* 11) — Insert ‘(*first revision*)’ after ‘oils’.

[*Page* 4, *table* 1, *Sl No.* (xiii), *col* 4] — Substitute ‘IS 12958:1990[12]’ *for* ‘standard under preparation’.

[*Page* 4, *table* 1, *Sl No.* (xiv), *col* 4] — Substitute ‘IS 13631:1993[13]’ *for* ‘appendix D of IS 335-1983[12]’.

[*Page* 4, *table* 1, *Sl No.* (xv), *col* 4] — Substitute ‘IS 13567:1992[14]’ *for* ‘IS 2362-1973[13]’.

[*Page* 4, *table* 1, *Sl No.* (xvi)] — Delete the entire row.

(*Page* 4, *table* 1, *end*) — Substitute:

‘[12]Oxidation stability of inhibited mineral insulating oil by rotating vessel – method of test[13] Method of test for detection & determination of antioxidant additives in insulating oils [14] Determination of water in insulating liquids & in oil – impregnated paper & press board by automatic coulometric karl Fishcer titration – method of test’ *for* ’[12] Specification for new insulating oils (*third revision*) [13]Determination of Water by the Karl Fischer method (*first revision*)’.

(ET 03)

Reprography Unit, BIS, New Delhi, India

Indian Standard

SPECIFICATION FOR INHIBITED MINERAL INSULATING OILS

0. FOREWORD

0.1 This Indian Standard was adopted by the Bureau of Indian Standards on 25 August 1988, after the draft finalized by the Liquid and Gaseous Dielectrics Sectional Committee had been approved by the Electrotechnical Division Council.

0.2 The preparation of this Indian Standard specification has been undertaken as the use of inhibited mineral insulating oil has started in the country for use with power transformer where greater oxidation resistance is required. The greater oxidation resistance is achieved with the addition of suitable oxidation inhibitor to the insulating oil conforming to IS : 335-1983*.

0.3 In preparing this standard, considerable assistance has been derived from ASTM D 3487-1979 'Specification for mineral insulating oil used in electrical apparatus', issued by the American Society for Testing and Materials.

0.4 For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS : 2-1960*. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

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*Specification for new insulating oils (*third revision*).

*Rules for rounding off numerical values (*revised*).

1. SCOPE

1.1 This standard specifies the requirements for unused insulating oil as delivered in bulk such as rail tank wagons and road tankers or drums, suitable for immersion or filling of transformers, switchgears, regulators, reactors and certain other electrical equipment in which the oil is required as an insulator for heat transfer.

1.1.1 The oils covered by this standard are inhibited low viscosity mineral oil mixed with a suitable oxidation inhibitor where greater oxidation resistance is required.

1.1.2 Before adding inhibitors, the oil covered by this standard shall fully conform to IS : 335-1983*.

1.2 This standard does not apply to:

a) uninhibited oil,

b) oil required for cables and switchgear requiring high viscosity oil or for special impregnation purposes, and

c) synthetic dielectric liquids.

2. TERMINOLOGY

2.0 For the purpose of this standard, the following definitions, in addition to those given in IS : 335-1983*, shall apply.

2.1 Inhibited oil — An oil for apparatus where greater oxidation resistance is required. This is usually achieved with the addition of a suitable oxidation inhibitor; ditertiary butyl-para-cresol, food grade.

DBPC food grade shall meet the requirements of DBPC technical as per IS : 9207-1979*. In addition, the following shall apply:

Characteristic	*Requirement*	*Method of Test*
Copper (as Cu) mg/kg, *Max*	Nil	IS : 7212-1974†
Iron (as Fe), mg/kg, *Max*	Nil	Appendix D of IS : 5343-1969‡

NOTE — During processing of inhibited mineral oil under vacuum and elevated temperatures; partial loss of inhibitor and volatile portions of mineral oil may occur. The common inhibitors 2, 6-ditertiary-butyl-para-cresol and 2, 6-ditertiary-butyl-phenol are more volatile than transformer oil. If processing conditions are too severe, oxidation stability of the oil may be decreased due to loss of inhibitor. The selectivity for removal of moisture and air in preference to loss of inhibitor and oil is improved by use of a low processing temperature.

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*Specification for new insulating oils (*third revision*).

*Specification for Di-tert-butyl-para-cresol, technical.

†Methods of determination of copper.

‡Butylated hydroxyanisole, food grade.

Conditions that have been found satisfactory from most inhibited mineral oil processing are:

Temperature (°C)	40	50	60	70	80	90	100
Minimum Pressure (Approximate Torr)	0·04	0·075	0·15	0·3	0·75	3·0	7·5

If temperatures higher than those recommended for the operating pressure are used, the oil should be tested for inhibitor content and inhibitor added as necessary to return inhibitor content to its initial value. Attempts to dry apparatus containing appreciable amounts of free water may result in a significant removal of inhibitor even at the conditions recommended above.

2.2 Additives — Chemical substances that are added to mineral insulating oil to achieve required functional properties.

2.3 Functional Properties — Those properties of the mineral insulating oil which are required for the design, manufacture and operation of the apparatus. These properties are listed in **4**.

3. COMPOSITION

3.1 The oil shall be hydrocarbon oil with prescribed oxidation inhibitor, clean and sufficiently free from moisture or other foreign matter likely to impair its properties.

4. REQUIREMENTS

4.1 The characteristics of the oil, when it is sampled (*see* **6**) and tested in accordance with the methods referred to in Table 1, shall comply with the reqiurements specified in Table 1.

5. PACKING

5.1 The oil may be delivered in perfectly clean steel drums of 200 litres nominal capacity Type A or Type B conforming to IS : 1783-1983*. The drums may be coated from inside with suitable coating (for example, epoxy lacquer, phosphate) resistant to insulating oil. The outside surface of the drum shall be coated with suitable primer and finishing paint or hot dip galvanized conforming to IS : 4759-1984†, for protection against atmospheric corrosion. The drums shall be effectively sealed immediately after filling the oil to exclude moisture.

NOTE 1 — Clean drums, specially reserved, should be used for the purpose of delivering and storing insulating oil.

NOTE 2 — Oil in drums cannot be expected indefinitely to retain the electrical characteristics shown at the time of filling which are likely to deteriorate during storage.

5.2 Oil may also be delivered in road or rail tank wagons specially clean and reserved for this purpose and shall be suitably sealed so as to exclude moisture.

6. SAMPLING

6.1 Sampling of the oil shall be done in accordance with IS : 6855-1973*.

7. MARKING

7.1 Each drum shall be indelibly marked with the following:

a) Manufacturer's name or trade-mark;
b) Quantity in litres;
c) Name of the material;
d) The words 'low viscosity type'; and
e) Identification in code or otherwise to enable the date and lot of manufacture to be traced back to the factory records.

7.1.1 The containers may also be marked with the Standard Mark.

NOTE — The use of the Standard Mark is governed by the provisions of the Bureau of Indian Standards Act, 1986 and the Rules and Regulations made thereunder. The Standard Mark on products covered by an Indian Standard conveys the assurance that they have been produced to comply with the requirements of that standard under a well-defined system of inspection, testing and quality control which is devised and supervised by BIS and operated by the producer. Standard marked products are also continuously checked by BIS for conformity to that standard as a further safeguard. Details of conditions, under which a licence for the use of the Standard Mark may be granted to manufacturers or processors may be obtained from the Bureau of Indian Standards.

7.2 When supply of insulating oil is made in road or rail tank wagons, it shall be accompanied with a certificate giving information as required in **7.1**.

8. TESTS

8.1 The tests shall be carried out in accordance with the test methods referred to in Table 1.

8.1.1 *Quality of Reagents* — Unless specified otherwise, pure chemicals and distilled water (*see* IS : 1070-1977†) shall be employed in tests.

NOTE — 'Pure chemicals' shall mean chemicals that do not contain impurities which affect the test results.

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*Specification for drums, large, fixed ends (*second revision*).

†Specification for hot-dip zinc coatings on structural steel and other allied products (*second revision*).

*Method of sampling for liquid dielectrics.

†Specification for water for general laboratory use (*second revision*).

TABLE 1 SCHEDULE OF CHARACTERISTICS

(*Clauses* 4.1 *and* 8.1)

SL No.	CHARACTERISTIC	REQUIREMENT	METHOD OF TEST	REMARKS
(1)	(2)	(3)	(4)	(5)
i)	Appearance	The oil shall be clear and transparent and free from suspended matter or sediments	A representative sample of the oil shall be examined in a 100 mm thick layer at 27°C	—
ii)	Density at 29·5°C, *Max*	0·89 g/cm^3	IS : 1448 [P : 16]-1977[1]	—
iii)	Kinematic viscosity at 27°C, *Max*	27 cSt	IS : 1448 [P : 25]-1976[2]	—
iv)	Interfacial tension at 27°C, *Min*	0·04 N/m	IS : 6104-1971[3]	—
v)	Flash point, Pensky-Marten (closed), *Min*	140°C	IS : 1448 [P : 21]-1970[4]	—
vi)	Pour point, *Max*	–6°C	IS : 1448 [P : 10]-1970[5]	—
vii)	Neutralization value:			
	a) Total acidity, *Max*	0·03 mg KOH/g	IS : 1448 [P : 2]-1967[6]	—
	b) Inorganic acidity/alkalinity	Nil	do	
viii)	Corrosive sulphur	Non-corrosive	Appendix A of IS : 335-1983[7]	—
ix)	Electric strength (breakdown voltage), *Min*:		IS : 6792-1971[8]	*See* Note 2
	a) New unfiltered oil	30 kV (rms)		
	b) After filtration	If the above value is not attained, the oil shall be filtered 60 V (rms)		
x)	Dielectric dissipation factor ($\tan \delta$) at 90°C, *Max*	0·002	IS : 6262-1971[9]	*See* Note 2

NOTE 1 — The test on inhibited oil may also be carried out if desired by the purchaser.

NOTE 2 — As a consequence of the tendency for water absorption to occur due to the breathing on storage even when drums are sealed the oil shall be filtered before the test as follows :

The oil is brought to 90 ± 2°C, then filtered hot under vacuum (corresponding to a pressure of less than 2·67 kN/m^2). The filter shall be sintered glass of porosity 4. The filtrate is cooled in a desiccator and used immediately to measure electric strength.

NOTE 3 — The density correction factor of oil (conforming to this standard) over the range of normal operating temperature is approximately 0·000 65 per degree celsius.

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[1] Methods of test for petroleum and its products: [P: 16] Density by hydrometer method (*second revision*).

[2] Methods of test for petroleum and its products: [P : 25] Kinematic viscosity (*first revision*),

[3] Method of test for interfacial tension of oil against water by the ring method.

[4] Methods of test for petroleum and its products: [P : 21] Flash point (closed) by Pensky-Martens apparatus (*first revision*).

[5] Methods of test for petroleum and its products: [P : 10] Cloud point and pour point (*first revision*).

[6] Methods of test for petroleum and its products: [P : 2] Acidity (*first revision*).

[7] Specification for new insulating oils (*third revision*).

[8] Methods for determinations of electric strength of insulating oils.

[9] Methods of test for power factor and dielectric constant of electrical insulating liquids.

(*Continued*)

TABLE 1 SCHEDULE OF CHARACTERISTICS — *Contd*

Sl No.	Characteristic	Requirement	Method of Test	Remarks
(1)	(2)	(3)	(4)	(5)
xi)	Specific resistance (resistivity):		IS : 6103-1971[10]	*See* Note 2
	a) At 90°C, *Min*	35×10^{12} ohm-cm		
	b) At 27°C, *Min*	$1\,500 \times 10^{12}$ ohm-cm		
xii)	Oxidation stability:		IS : 12422-1988[11]	—
	a) Neutralization value after oxidation, *Max*	0·40 mg KOH/g		
	b) Total sludge after oxidation, *Max*	0·10 percent by mass		
xiii)	Oxidation stability (rotating bomb test), *Min*, minutes	195	Standard under preparation	—
xiv)	Oxidation inhibitor content	0·3 percent by mass, *Max*	Appendix D of IS : 335-1983[12]	—
xv)	Water content, *Max*	50 ppm	IS : 2362-1973[13]	
xvi)	SK value, *Max*	Under consideration	Appendix F of IS : 335-1983[12]	

[10] Method of test for specific resistance (resistivity) of electrical insulating liquids.

[11] Test method for oxidation stability of inhibited mineral insulating oils.

[12] Specification for new insulating oils (*third revision*).

[13] Determination of water by the Karl Fischer method (*first revision*).

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